

## SECTION 2 - INTRODUCTION TO SUSTAINABLE DESIGN



Iowa Sustainable Design Initiative



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INTRODUCTION TO SUSTAINABLE DESIGN

# Introduction to Sustainable Design

## Sustainable Design Principles

There are five main sustainable design principles:

- Sustainable Sites
- Water Efficiency
- Energy & Atmosphere
- Materials & Resources
- Indoor Environmental Quality

This section on sustainable design provides background information to address the following questions:

- What is sustainable design?
- What are the benefits of sustainable design?
- Who is using sustainable design?

## What is Sustainable Design?

Sustainable design addresses building and site design, construction, and operation, including any decisions that impact the natural environment, people, and/or long-term financial costs.

The term sustainable design is often used interchangeably with the terms “green design” and “high-performance design.” Characteristics of a sustainable design often include: durable, flexible, healthy, energy efficient, and resource efficient. Sustainable design is applicable to all types of projects regardless of project size, scope, or budget. Sustainable solutions can be integrated into both renovations and new construction.

Designing and constructing a building is a long and often complex process. To best organize and implement sustainable design principles into this process, the green building industry and the Iowa Sustainable Design Initiative have adopted the following five principles: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, and Indoor Environmental Quality.

**Principle 1: Sustainable Sites** – Sustainable site design minimizes the impact a building has on the existing environment. Sites developed to sustainable standards reduce water volumes needed for landscaping, reduce storm water runoff, and conserve natural habitat. Sustainable site development takes advantage of existing terrain and environmental conditions to increase occupant comfort while reducing energy use.

The Neal Smith National Wildlife Refuge Prairie Learning Center in Jasper County is a low-lying, modern structure that blends neatly into the prairie landscape. The center serves as a world-class prairie exhibition and educational facility. The refuge consists of more than 5,000 acres of tall-grass prairie and native Midwest wildlife. The refuge recreates the native plant and animal communities that greeted Iowa’s earliest settlers in the mid 1800s. This sustainable site supports and nurtures grazing herds of buffalo, elk, and white-tailed deer, as well as pheasants and badgers.

**Principle 2: Water Efficiency** – Fresh water is becoming increasingly scarce, and building construction and operation can play an important



Tall-grass prairie at the Neal Smith National Wildlife Refuge Prairie Learning Center, Prairie City, Iowa



Storm water management, (NO HYPEN)  
Iowa Association of Municipal Utilities Office and Training Headquarters, Ankeny, Iowa

*Photograph by Assassi Productions-  
Santa Barbara, California*

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role in protecting and conserving water. Sustainable buildings and sites reduce total water usage while protecting watersheds and water quality.

The Iowa Association of Municipal Utilities (IAMU) Office and Training Headquarters in Ankeny, Iowa, has many sustainable attributes. Many steps were taken to minimize and retain storm water on the site and naturally filter wastewater. Fill from site excavations was used to create wetlands, siltration ponds, and wetland septic systems.

Storm water and soil were retained on the site during construction. Variances were secured for the parking and drive designs to allow for natural infiltration and drainage into the constructed and natural wetlands. The restored natural prairie creates habitat and helps prevent further soil erosion from wind and water. This also reintroduces native plants to an area that has been depleted through agrarian practices. The building's wastewater is treated through a biological wetland treatment system.

**Principle 3: Energy & Atmosphere** – Buildings use more than 30 percent of all energy generated domestically. Generating this energy has a profound negative impact on the environment including: carbon emissions, interrupted rivers from damming, degradation from oil, natural gas, and coal extraction, and more. Sustainable buildings conserve and sometimes even generate energy. Renewable, non-polluting means of generating electricity are also considerations with respect to energy and atmosphere.

The University of Northern Iowa's Center for Energy and Environmental Education in Cedar Falls was designed not only to house a range of environmental education programs, but also to serve as a model for energy-efficient and resource-efficient construction. The design places the building along an east-west axis that establishes a long southern exposure. Glazing on the south provides for direct gain and appropriately sized overhangs shade the glass during the hottest part of the summer. Inside the building a long, limestone wall is both an attractive design element and a thermal mass. Windows are low-e, argon filled, with vinyl-clad wood casings. A very important part of the solar design is daylighting in almost all interior spaces. A significant amount of the total energy savings comes from this feature.

**Principle 4: Materials & Resources** – Buildings require a tremendous amount of natural resources. For example, every day 23 million tons of concrete are poured worldwide. The extraction, transportation, and processing of natural resources creates environmental damage. The environmental pressure does not stop there. When a building is demolished, the majority of the materials are bound for the landfill. In fact, construction and demolition waste accounts for approximately 40 percent of landfill volume in the United States. Careful planning and



Exterior of the Iowa Association of Municipal Utilities Office and Training Headquarters, Ankeny, Iowa

*Photograph by Assassi Productions- Santa Barbara, California*



Recycled-content materials were used in the construction of the Bettendorf Family Museum of Arts and Sciences, Bettendorf, Iowa

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Vision glazing and clerestory windows, Golden Hills Resource Conservation and Development Office, Oakland, Iowa

execution of a comprehensive sustainable design program will lessen the use of natural resources and reduce landfill volumes resulting from building.

The Bettendorf Family Museum of Arts and Sciences in Bettendorf, Iowa, incorporates many sustainable materials. PET (polyethylene terephthalate) carpeting was used, keeping 28,250 plastic soda bottles out of a landfill. Wainscoting on the main floor was made from wood from a certified forest. The following recycled content products were used: gypsum wallboard, countertop (recycled newsprint), floor tile (recycled scrap), lawn furniture (recycled high-density polyethylene – HDPE#2), play surface (recycled rubber tires), and structural steel. In addition, waste materials comprised of 12 tons of wallboard and 120 cubic yards of corrugated cardboard were recycled during construction.



Clerestory windows, Iowa Association of Municipal Utilities Office and Training Headquarters, Ankeny, Iowa  
*Photograph by Assassi Productions- Santa Barbara, California*

**Principle 5: Indoor Environmental Quality** – According to the U.S. Environmental Protection Agency, the average person spends about 90 percent of their time indoors, yet they usually do not consider the unhealthy effects of many indoor environments. Providing healthy indoor environments will increase occupant comfort and produce other benefits. For example, it is well documented that simply providing daylight to students will result in improved test scores. Retailers who provide natural light have experienced higher sales. Taking steps to address anything that impacts an occupant's health and comfort characterize good indoor environmental quality. This includes, for example, temperature, humidity, acoustics, access to natural light, and air quality.

At the Golden Hills Resource Conservation and Development Office in Oakland, Iowa, quality of the indoor environment was a priority. The interior was adequately lit with natural light, low-emitting materials were used, and the employees can open the windows.

## Integrated Sustainable Design

For a building to be considered sustainable, all of the categories above should be addressed. It is no longer acceptable to call a building sustainable if, for example, it only addresses energy efficiency.

The Iowa Association of Municipal Utilities (IAMU) Office and Training Headquarters is an excellent example of sustainable design. The project, located in Ankeny, Iowa, and designed by RDG Planning & Design, was conceived as a teaching tool. In addition to the sustainable site and water features noted above, the building includes other sustainable successes.

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Sustainable Sites. This project has restored a suburban farm field, destined for commercial development, into a native Iowa tall-grass prairie. Soil erosion had been plaguing the site, harming nearby Carney Marsh, a 40-acre protected wetland. The reconstructed prairie, wetlands, and siltration ponds have recreated habitat for flora and fauna.

Water. There is no exterior irrigation system, which saves on water consumption. Low-flow 1-gallon flush toilets were installed.

Energy. Energy consumption is 55 percent less than a conventional design, and the building is 98 percent naturally lit. Electric light is used only as a supplement to daylight. The building uses a geothermal heat pump system for heating and cooling.

Materials and Resources. Various structural, exterior, and interior materials were evaluated based on cost, sustainable characteristics, and embodied energy.

Indoor Environmental Quality. Building occupants enjoy multiple views of the landscape and sky from any point inside the building.

IAMU's 13,000 square-foot building was a recipient of the American Institute of Architects Committee on the Environment Top 10 "Green" Buildings in 2002.



Use of Natural Light-  
University of Northern Iowa  
Center for Energy and  
Environmental Education;  
Cedar Falls, IA



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## Benefits of Sustainable Design

Sustainable design offers multiple benefits to building occupants, the environment, and economic benefits.

**Occupant Benefits** – The benefits realized by those who work and live in sustainable buildings are many. A sustainable building is one that is designed with the health and comfort of building occupants in mind. It recognizes the value of daylight to provide better illumination and reduce energy costs. Toxic gases emitted from paint, finishes, carpets, furniture, and external sources can be reduced or eliminated. Indoor thermal comfort is promoted by local controls to adjust to changes in weather and individual preference. Building occupants and owners/operators benefit from these types of features with:

- improved performance, whether it is production or learning comprehension;
- longer employee retention;
- reduced employee absence due to illness;
- decreased risk of toxic exposure from mold and mildew or pollutants; and
- increased satisfaction.



Building –exterior, Wickiup Hill Outdoor Learning Center, Toddville, Iowa

*Photograph by Linn County Conservation*

Bronson Methodist Hospital in Kalamazoo, Michigan, seeks to create a healing environment through an indoor garden, intuitive wayfinding, artwork, private rooms and materials and finishes that reflect nature and healing. Since opening its new facility in November 2000, the following has been observed:

- nursing vacancy rates are half the state average;
- patient transfers are down due to private patient rooms;
- patient sleep quality is up, also due to private patient rooms; and
- market share has increased one percent, and through July 2001, there were 1,000 more year-to-date admissions than in all of 2000.

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**Environmental Benefits** – Perhaps the most motivational reason for many people to “go green” is to protect the natural environment. Sustainable design protects and even celebrates nature in many ways. For example, using:

- local materials reduces energy used to transport materials;
- indigenous vegetation reduces water use, pesticides, and preserves local ecologic conditions; and
- renewable energy when feasible, such as solar or wind-generated power, improves air quality.

When sustainable design principles are used, the environment also receives indirect benefits. For example, many of the methods above reduce energy use. Curbing energy use:

- reduces carbon emissions from power generation plants;
- leads to reduced extraction of natural resources to power these plants;
- reduces transportation to move these resources to the generation plants;
- demands less infrastructure to deliver the power to consumers who create less heat from HVAC systems;
- reduces cooling loads;
- lessens machinery required to provide cooling; and
- encroaches less on the environment; and so on.

Something as simple as installing additional insulation can have a significant benefit to the environment if widely used. Sustainable design does matter to the natural environment.

The Wickiup Hill Outdoor Learning Center in Toddville, Iowa, provides a superb gathering point for all activities with many exhibits, classroom space, and area support facilities. Groups are encouraged to explore the archaeological areas, learn about Native American use of the wetland, prairie and woodlands, and view the interpretive signs along the trails. Not only did the design of this building minimize impact on the natural environment, the facility also serves as an educational center to teach the benefits of doing so.

**Economic Benefits** – Building owners can save on operating and maintenance costs over the life of the building when sustainable design

## SIFIC

The State of Iowa Facilities Improvement Corporation (SIFIC) program encourages state facilities to design sustainably and provides assistance to study and finance energy management improvements.

Energy saving measures are important sustainable design features. “Iowa taxpayers are now saving \$22.7 million annually, thanks to the DNR’s Building Energy Management programs.”

*Building Energy  
Management Annual Report  
for FY 2002*

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is used. This may be related to reduced energy use; increased occupancy rates in leased facilities; decreased liability from potential indoor air quality problems; increased efficiencies from occupants; or reduced water use.

It should be noted that some benefits are not easily measurable, such as productivity increases, reduction in absenteeism, or enhanced occupant satisfaction. These benefits can actually far outweigh energy savings over the life of the building. There are many studies under way to investigate such relationships. Some examples are provided in the resources list at the end of this section.

While it is possible for a building that is designed with sustainable principles in mind to cost less, this is not well documented. Up-front construction costs may be reduced by:

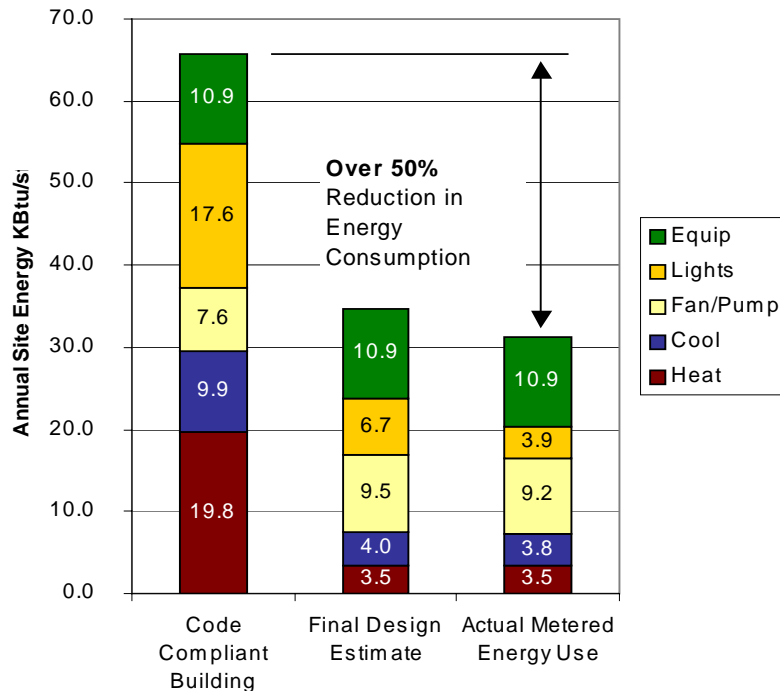
- decreased cost of materials (for example, local materials may cost less due to reduced transportation costs, or recycled and reclaimed materials may cost less);
- fewer mistakes resulting from increased communication throughout the entire design and construction process; and
- increased availability of incentives for green buildings in the form of tax credits, reduced interest rates, grants, and cost-sharing programs.

The Weidt Group of Minnetonka, Minnesota, provided energy modeling during the design of the Iowa Association of Municipal Utilities (IAMU) building. The following graph shows how the building would perform if it was designed to the minimum efficiency allowed by building code. The middle column indicates how the computer-generated model predicted the building would perform as designed – more than 50 percent better than code! Even more impressive is that the IAMU facility's actual energy performance has been 10 percent to 15 percent lower than estimates. Long-term building environmental and energy monitoring are being performed to further evaluate and improve the building's operation.



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## Model of Energy Usage for the Iowa Association of Municipal Utilities provided by the Weidt Group \*



\* When printed in black and white, the key order on the graph is the same as that shown on the legend located to the right.

## Who is Using Sustainable Design?

During the last few years, sustainable design has become a part of mainstream practice. In the mid1990s, the federal government issued several Executive Orders that required federal agencies to address sustainable issues. The orders first addressed individual issues such as energy and water consumption and later addressed integrated sustainable design. Agencies, including the Navy and the General Services Administration, quickly realized the benefits of sustainable design and began incorporating sustainable principles into their designs. Almost all federal agencies now have some type of initiative or requirements for sustainable design. City and state governments quickly followed suit, some writing their own executive orders. Now, building owners of all types, including public and private, are "going green."

### LEED Influence

Sustainable design is becoming part of mainstream practice. One of the significant indicators is the increased use of the LEED Green Building Rating System.

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One of the products transforming the industry is the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED™) Green Building Rating System. It is the first, and currently the only, national green building rating system in the United States. It provides a definition of what is considered a sustainable building.

	2001	2002	2003
<b>Registered Projects, noting intent to become LEED certified</b>	230	331	441
<b>LEED Accredited Professionals, who have passed a LEED exam</b>	527	1916	3535
<b>LEED Certified Projects</b>	5	21	51
<b>Cumulative square footage of LEED Registered Projects (in millions of square feet)</b>	>51	>78	>139

More information on LEED is provided in the Rating Systems' section. Information about how other states are addressing sustainable design is found in Appendix A.

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## Related Resources

Contacts	Description	Contact Information
<b>Environmental Building News (EBN)</b>	EBN is a monthly publication with articles, reviews, and news stories on energy-efficient, resource-efficient, and healthy building practices.	Environmental Building News – BuildingGreen, Inc.  122 Birge Street Suite 30 Brattleboro, VT 05301 Telephone: (802) 257-7300  Website:  <b><a href="http://www.buildinggreen.com">http://www.buildinggreen.com</a></b>
<b>Iowa Green Buyers Guide</b>	The Iowa Green Buyers Guide provides recommendations for product selection based on a number of environmental issues. These factors include, but are not limited to, recycling, product stewardship, health concerns, energy benefits, local initiatives and arrangements. Additionally, readers are directed to additional links where they may find more on the subject.	Iowa Department of Natural Resources  502 E. 9 <sup>th</sup> Street, Wallace State Office Building Des Moines, IA 50319-0034 Telephone: (515) 281-4367  Website:  <b><a href="http://www.sustainableiowa.org/GreenbuyersGuide.html">http://www.sustainableiowa.org/GreenbuyersGuide.html</a></b>

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## Related Resources (continued)

Contacts	Description	Contact Information
<b>Iowa Sustainable Design Case Studies</b>	The case studies on this web site all demonstrate some aspect(s) of sustainable design. There are many excellent examples of sustainable design in Iowa, many of which were designed and constructed prior to the development of the Iowa Sustainable Design Initiative.	Iowa Department of Natural Resources 502 E. 9th Street, Wallace State Office Building Des Moines, IA 50319-0034 Telephone: (515) 281-4367  Website:  <b><a href="http://www.sustainableiowa.org/IACaseStudies.html">http://www.sustainableiowa.org/IACaseStudies.html</a></b>
<b>U.S. Green Building Council (USGBC)</b>	The USGBC is the nation's foremost coalition of leaders from across the building industry working to promote buildings that are environmentally responsible, profitable and healthy places to live and work.	USGBC 1015 18th Street, NW, Suite 805 Washington, DC 20036 Telephone: (202) 828-7422  Website:  <b><a href="http://www.usgbc.org">http://www.usgbc.org</a></b>

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